MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

EEL1166 – CIRCUIT THEORY

(All sections / Groups)

13th MARCH 2019
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE** pages including cover page with **FOUR** questions only.

2. Answer **ALL** questions and print all your answers in the answer booklet provided.

3. All questions carry equal marks and the distribution of the marks for each question is given.

Question 1

(a) State the principle of superposition in a linear system. With the aid of diagrams, briefly explain how you can apply the superposition theorem method in a simple circuit. [2+4 marks]

(b) Consider the circuit shown in **Figure Q1(b)**. Find the voltage, V_0 across the 5Ω resistor using superposition theorem **ONLY**. [13 marks]

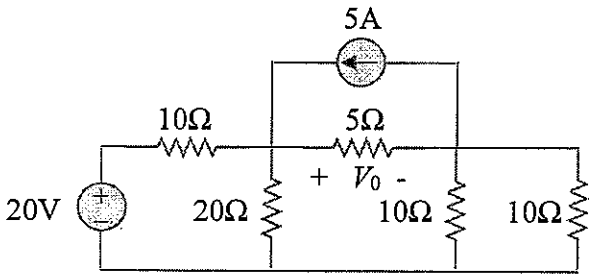

Figure Q1(b)

(c) For the Thevenin's equivalent circuit shown in **Figure Q1(c)**,

(i) Convert and draw its Norton's equivalent circuit. [2 marks]

(ii) Design the circuit so that it fulfills the maximum power transferred theorem with a load power of 50W. [4 marks]

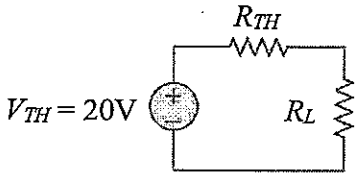

Figure Q1(c)

Continued...

Question 2

(a) For the circuit shown in **Figure Q2(a)**,

(i) Define the term essential node? List all the essential nodes in the figure. [2+4 marks]

(ii) Using nodal analysis, solve the unknown voltages v_2, v_3 and v_4. [8 marks]

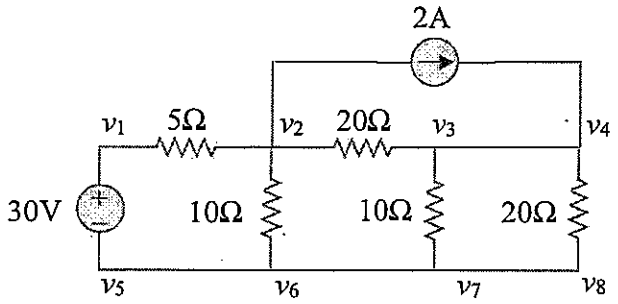

Figure Q2(a)

(b) Consider the periodic signal, Y defined by the equations:

$$Y(t)=\begin{cases} t, & 0<t\le 2 \\ 2, & 2<t\le 4 \\ 6-t, & 4<t\le 6 \end{cases} \text{ and } Y(t)=Y(t-6)$$

(i) Draw the signal waveform by labeling clearly the x-axis and y-axis. [3 marks]

(ii) Calculate the period, average value, root mean square value and form factor of the signal, $Y(t)$. [8 marks]

Continued...

Question 3

(a) For the ac circuit shown in **Figure Q3(a)**, calculate the followings:

(i) Total impedance. [4 marks]

(ii) Current, $i(t)$. [5 marks]

(iii) Voltage, $v(t)$. [3 marks]

(iv) Complex power across the series RC impedance. [2 marks]

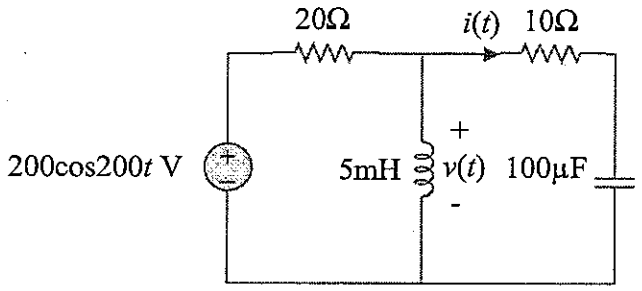

Figure Q3 (a)

(b) A parallel RLC circuit consists of a resistance of 500Ω, an inductor of 20mH and a capacitor of 100μF. An 50Hz 50V AC voltage source is applied across the combination.

(i) Define quality factor. What is the relationship between quality factor and half power bandwidth? [2 + 2 marks]

(ii) Calculate the quality factor and the half power bandwidth. [4 marks]

(iii) Determine whether the RLC circuit is a resonant or non-resonant circuit. [3 marks]

Continued...

Question 4

(a) The switch of a RC circuit shown in **Figure Q4(a)** has been closed for a long time. When $t = 2$s, the switch is opened.

(i) Briefly explain the working principle of charging and discharging a capacitor. [6 marks]

(ii) Derive the equation for capacitor voltage, $v_C(t)$ at charging phase when $t < 2$s and discharging phase when $t \geq 2$s. [4 marks]

(iii) Calculate the time constant, τ and capacitor voltage, $v_C(t)$ at $t = 4$s. [4 marks]

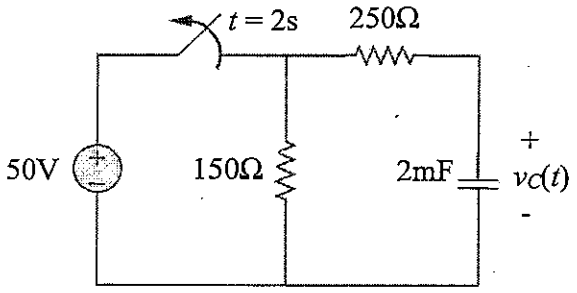

Figure Q4(a)

(b) A source free series RLC circuit with its capacitor fully charged initially is shown in **Figure Q4(b)**. The impedance values, are given as $R = 30\Omega$, $L = 500$mH and $C = 500\mu$F.

(i) Formulate the characteristic equation. [3 marks]
(Hints: $As^2 + Bs + C = 0$)

(ii) Calculate the damping factor, α and resonant frequency, ω_0. [4 marks]

(iii) Is the circuit having under damped, over damped or critically damped response? Draw the response of the circuit. [2+2 marks]

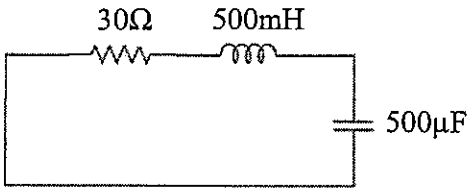

Figure Q4(b)

End of Paper